board slide of the plateholder. Bits of sheet aluminum (¼ mm. thick) and of sheet lead (¾ mm. thick) were laid upon the cardboard slide of the plateholder. Two to five hours' exposure to a 900 Watt arc at a distance of 25 cm. produced no perceptible effect.

The bits of sheet metal were then for convenience placed next to the gelatine film and the plates, masked with two thickness of black cardboard, were exposed to the arc for three hours at a distance of about 12cm. The plates become quite hot, about 80°C. after development the action was found to be quite strong where the plate was not screened by the bits of metal. The bits of metal, each several square centimeters in area, screened the plates about equally. The portions of the films under the bits of metal showed very faintly the texture of metal surface, as if by reflection.

The plates were then arranged so as to obviate excessive heating by ventilation, and masked with two thicknesses of black cardboard and two to four thicknesses of mask paper, the bits of sheet metal being placed outside the cardboard slide of the plate holder as at first. Three hours' exposure at a distance of 15 cm. from the arc produced no perceptible effect.

The arc was then arranged to play between zinc and carbon, taking about ten amperes at thirty-five volts. The plates arranged as described in the previous paragraph were exposed to this zinc arc for two hours at a distance of about ten centimeters. The zinc rod was cathode for about one hour and anode for about one hour. No perceptible effect was produced.

It seems justifiable to conclude from these experiments that Röntgen rays are not given off in any abundance by the electric arc, and that they are not of the same nature as the ultra-violet of the spectrum, or at least that they are not of the same nature as the ultra-violet, which is present in any abundance in the light emitted by the electric arc between carbon electrodes or between zinc electrodes.

In demonstrating the presence of Röntgen rays it is necessary in every case to exercise the greatest care in the rigid exclusion of every other agent capable of affecting the sensitive plate, such as ordinary and ultra-violet light, electric charge acting directly upon the film, mechanical pressure, high temperature, etc. These rays and the cathode rays are distinguished among all other actinic radiations by the facility with which they pass through metals and from each other by their different behavior in the magnetic field, as appears from Röntgen's paper.

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SCIENTIFIC LITERATURE.

Grundzüge der Marinen Tiergeographie. Anleitung zur Untersuchung der geographischen Verbreitung Mariner Tiere mit besonderer Berücksichtigung der Dekapodenkrebse. Von DR. ARNOLD E. ORTMANN, in Princeton, N. J., U. S. A. Mit 1 Karte. Jena, Verlag von Gustav Fischer. 1896. Pp. 96. M. 2.50.

This is an excellent contribution to zoögeography, which ought to be in the hands of everybody interested in the fascinating questions of animal distribution. A great number of highly interesting points are also discussed, important for the biologist and geologist.

The principal aim of this work, the author states in the introduction, is to call the attention of the scientific world to the highly interesting study of the distribution of marine animals hitherto greatly neglected. Before all, the principles had to be established, according to which the distribution of marine animals has to be examined; in doing so it was necessary to discuss the general principles of animal distribution. Since the question of the distribution of species is most intimately connected with that of their origin the latter had to be examined, and the result is reached that the principle of separation or isolation is one of the most important factors. As an example of distribution Dr. Ortmann selected the group of decapod crustaceans, of which he has made special studies. He finishes his introductory remarks with the very pertinent sentence that without extensive and critical systematic preliminary work fruitful geographical studies are absolutely impossible.

The work is divided into seven chapters. The first chapter gives an historical review of the development of zoögeographical science. He distinguishes three periods.

1st *period.* The oldest attempts of A. Wagner, L. Agassiz, Dana and Schmarda.

2d *period.* To A. Agassiz and Wallace. The period of the discussion about the number of zoögeographical regions, and the first attempt to lay a scientific basis for zoögeography.

3d *period.* From Wallace to Heilprin, Trouessart and Döderlein. The period of the special researches on single groups of animals, with more or less considerable acceptance of the principles of Wallace; full treatment of single groups.

At the end of the chapter Ortmann refers to a very important paper of Pfeffer: Versuch über die erdgeschichtliche Entwicklung der jetzigen Verbreitungsverhältnisse unserer Thierwelt, Hamburg, 1891, which he considers as possibly the best ever published on zoögeography; he also refers to the new work of J. Walther. Einleitung in die Geologie als historische Wissenschaft I. Theil. Bionomie des Meeres. Beobachtungen über die marinen Lebensbezirke und Existenzbedingungen. Jena. 1893.

The second chapter treats of the most important physical life conditions, the life regions and the facies ('Bionomy'). Ortman distinguishes the following life regions.

1. The terrestrial region of *Terrestrial* (continental).
2. The fresh-water region or *Fluvial.*
3. The litoral region or *Litoral.*
4. The pelagic region or *Pelagial.*
5. The abyssal region or *Abyssal.*

After this the adaptations of the organisms to the life regions are discussed. The organisms are divided into two groups according to their dependence on the bottom * (Substrat). Animals which are dependent on the bottom and are unable to free themselves from it constitute the Benthos (Haeckel); animals which are not dependent on the bottom, those which during their lifetime never need to come into connection with the coast or the bottom of the ocean constitute the *Plankton* (Haeckel). Among the benthonic animals three groups are distinguished according to their more or less intimate connection with the bottom; first, *sessil benthos*, attached to the bottom, receiving food from outside; second, *vagile benthos*, creeping and running on the bottom to obtain food; and third, *nectonic benthos*, able to swim, able to leave the bottom at times, but always forced to return to it. The nectonic condition forms the transition to the *typical plankton*, which is independent of the bottom. The three groups of *benthos* are characteristic for the litoral and abyssal. The true *plankton* is characteristic for the pelagial.

The condition of the facies is of course of the highest importance for the organism. Ortmann distinguishes *primary* and *secondary* facies, the first is formed only by anorganic, the second also by organic material; but of course there are many combinations of the two. Each life region, however, with the exception of the open sea, has its special facies. The basis of the continental facies is the geological structure of the continents. Of great importance are the physiographic differentiations of the land.

In the fluviatile life regions the conditions are similar, but here much depends on the different nature of the medium; that is, the nature of the course of the water—lakes, rivers, etc.

The *litoral*, through its numerous relations to the land, and its frequent dependence on the nature of the latter, shows very numerous differences in its facies.

The facies of the *abyssal* consists of the smallest disintegrated products of minerals and rocks, accompanied by remains of terrestrial and marine organisms.

The *pelagial* has no facies. Peculiarities are produced, however, in the sargassum-masses.

The third chapter is headed: *Distribution of Animals. Increase and prevention of distribution. Means of Distribution.* It begins with the definition of the principle of separation and migration, which is of the greatest importance for the understanding of the processes connected with the origin of species and which is inseparable from zoögeography. This important principle was especially studied by Moriz Wagner, but, as Ortmann very properly states, has been misunderstood by many authors, or not accorded its full value. In order to estimate correctly the value of this principle, and in order

* Brooks, William K. Salpa in its Relation to the Evolution of Life. Stud. Biol. Labor. Johns Hopkins Uni., Vol. V., No. 3, May, 1893. (This paper was unknown to the author.)

to show that without this principle of isolation differentiation of species is unimaginable, Ortmann gives his view on the origin of variations and their modification in different species. In regard to the origin of variations he follows those authors which explain variation by direct adaptation of the surroundings (I would prefer to say by the direct influence of the surroundings). He is entirely opposed to Weismann's idea, according to which variation originates by Amphimixis, *i. e.*, the union of two elements (germplasmas of different kind). His principal objection is that Weismann, in order to explain the origin of variation, introduces the principle of Amphimixis, but allows this to operate with material already varied, the difference of the germplasmas. Weismann, in order to explain the origin of differences, takes for granted their preëxistence. For this reason alone Amphimixis as the source of variation is inadmissible. On the other hand it is known by experience that amphimixis, if operating with different material, will not produce new, but will unite together existing differences, especially if the different material is already similar and closely related. In this connection he refers especially to a paper by Pfeffer: Die inneren Fehler der Weismann'schen Keimplasma-theorie. Verhandl. Naturw. Ver. Hamburg (3) I., 1894, which seeems to be very little known.*

The two factors which form the basis for the process of the formation of species are according to Ortmann: 1, the adaptability of the organisms themselves to the external conditions, and 2, the possibility of the inheritance of the characters thus acquired. To these a third factor is added, *natural selection*. Natural selection operates in such a way that out of the number of existing forms those are exterminated which are unfavorably placed. It is not a selection of the fit, but a destruction of the unfit. By this destruction of the bad individuals the average of the totality is raised; that is, the average of the characters of the forms is changed quite gradually in a definite direction, determined by the external conditions existing at that moment. This process is called *transformation of species* (Pfeffer), or *mutation* (Waagen, Neumayr, also Scott, W. B., On Variations and Mutations, Am. Journ. Sc., 48, 1894, pp. 355–374).

It has been entirely overlooked by Weismann and many others that the process of mutation of *one* species or *one* group of forms is by no means identical with the formation of *new, contemporaneous different* species. Natural selection can only operate in such a way as to improve or modify, in the course of time, a series of forms or a species, as soon as the conditions of existence are changed; out of *one* form another can be produced by selection, but never *two*. The divergency of the directions of mutation, the origin of separate forms from *one* ancestral form, natural selection can never explain. This is only conceivable if the conditions of existence are also differentiated; that is, if they appear different in different regions of the earth at the same time, so that the ancestors of one form living in these different locations are subjected to special conditions. A successful effect of the different life conditions, however, can only be imagined, if the organisms are forced to remain *permanently* in these conditions, if they are prevented from migrating from one region of definite conditions of existence into others with other conditions. Therefore we have, as the *fourth* and most important factor in the formation of different species, the *separation* in *space* or *isolation*. I think everybody who has ever undertaken to study the geographical distribution of certain genera will agree with these views. I have emphasized it frequently,* as is fully admitted by Ortmann. The isolation prevents the cross-

* There are some other papers by G. Pfeffer, which are of great importance in these questions: Die Umwandlung der Arten ein Vorgang functioneller Selbstgestaltung. Verhandl. Naturwiss. Verein. Hamburg (3) I., 1894, 44 pp., and Die Entwicklung. Eine naturwissenschaftliche Betrachtung. Berlin. R. Friedländer und Sohn. 1895, 42 pp.

* Baur G. Das Variiren der Eidechsengattung Tropidurus auf den Galapagos Inseln. Biol. Centralbl. X. 1890, pp. 475–483. Leuckart. Festschrift 1892. pp. 259 ff. On the origin of the Galapagos Islands. Am. Nat. 1891., pp. 217–229, pp. 307–319. Ein Besuch der Galapages Inseln. Biol. Centralbl. XII. 1892. pp. 221–250. The Differentiation of Species on the Galapagos Islands and the origin of the group. Biol. Lect. Mar. Biol. Lab. Woods Holl 1894. Boston, 1895, pp. 67–78.

ing of the forms, and is fully comparable to artifical selection.

Ortmann ends his discussion with the following résumé: From these considerations it becomes evident that four factors contribute to the formation of different species: 1. *Adaptation to external conditions produces variations.* 2. *The inheritance of these adaptations fixes the variations and shapes groups of forms morphologically related.* 3. *Natural selection modifies the groups and produces mutation in a certain direction.* 4. *The isolation of groups produces differentiation in the direction of mutation and therefore formation of new species. All these 4 factors must coöperate; none can be absent, and none is possible without the others.*

Amphimixis operates in a conservative manner on the average characters, thus leveling the variations, which are capable of preservation, and which are not, therefore, injurious.

The principle of separation has an important bearing on zoögeography, since it follows that species must originate in isolated localities; they are bound to centres of origin. We want to know the place of origin of a given species which at present lives in a certain locality. Did it originate or immigrate there. From this it follows, that in the fauna of each single locality we have to distinguish: First species which originated there, *autochtons*, and second species which immigrated from other localities, *Immigrants*. A third group are the *relicts*, which formerly had an extensive distribution, but are now restricted to a few points. The decision of the nature of a certain animal form in a certain region, whether autochton, immigrant or relict, can only be given by systematics, and here the slightest detail must be considered. At this point zoögeography is not only most intimately connected with systematics, but entirely dependent on it.

The following pages discuss the law of the continuity of the areas of distribution, and the increase and prevention of distribution.

According to the principle of migration, the single animal forms can only extend to such regions as are in connection with the original center: This *is the law of the continuity of the areas of distribution.* It is a well known fact that the range of every species extends over a number of localities, which are separated from each other by smaller or larger gaps; these gaps, however, must not be so large that they could not be surpassed by the species in question; thus a continuous communication of the inhabitants of the single localities in which the species is found is possible. Only when this is the case can we speak of a *continuity of life conditions.* As soon, however, as this continuity is interrupted in such a way that it prevents the communication of the species, a *barrier* is formed which prevents its further extension. Continuity of life-conditions increases the distribution of animals; their interruption prevents it.

There are especially two factors which are of importance in this connection, for the first time clearly defined by Pfeffer, the *climatological* and the *topographical;* a third one has been added by Ortmann—*the biological.*

The effect of climatic conditions on the distribution of animals.

A uniform distribution of animals in their life districts presupposes uniformity of the climatic conditions, since all animals are highly dependent on temperature. The importance of the conditions of temperature was first pointed out by Dana; he considered the minimal absolute altitude which the animals need as the most important point, and constructed his *Isocrymes*, lines of equal lowest temperature. That the principle is not correct is generally admitted at present, and it has been replaced by another one. It is not so much the absolute altitude of the temperature which influences animal life, but it is the *Amplitude*, the amount of oscillation, since the temperature in the same locality oscillates according to the seasons. Möbius therefore has distinguished *stenothermous* and *eurythermous* animals. Stenothermous animals are unable to stand considerable oscillations; they are bound to a more uniform temperature; eurythermous animals are not affected by considerable changes. The fundamental difference between the marine and continental conditions of temperature is thereupon discussed. On the continents we have high amplitudes, the surface temperatures of the ocean being more uniform. Since the terrestrial animals are adjusted to high amplitudes—being eurythermous—their distribution is not so much influenced by the climatic differ-

ences; it seems, therefore, that *the topographical factors in the distribution of terrestrial animals are of more importance than climatic factors.*

The matter is different in the case of marine animals. The oscillations of temperature are not so extensive as those of the continents, and the amount of these oscillations is very different in different latitudes. Ortmann arrives at the following conclusion from the given data: *In the equatorial regions of the oceans a nearly uniform temperature prevails with only limited oscillations; these oscillations increase with the latitude, reach their maximum in the temperate and decrease again to a smaller amount in the highest latitudes, the polar regions.*

The conditions on the surface of the oceans are of course different from those at some depth, and the coasts have also an influence on the litoral region. The oscillations of temperature in the sea will appear especially in the upper layers which are exposed to the direct influence of the sun, that is principally in the litoral and pelagial. With increasing depth they decrease and are reduced to a minimum in the deep sea. As is well known, the abyssal has a very constant low temperature, and therefore we cannot expect any climatic effect on the distribution of its animals.

Effects of the topographical conditions on the distribution of animals. Combination of the climatic and topographic principle.

The *continental* is composed of a number of completely separated landmasses; which approach each other closely in the northern hemisphere, but which are always separated by the sea. This character is fundamental and conditions a different development of animals in the separate land areas. These topographical conditions are more important than the climatic differences. A similarly extensive topographical segregration is seen in the *fluvial*; it is even still more highly differentiated, consisting of a very great number of topographically isolated portions, which very often may be connected with one another. These two life zones are distinguished from the marine zones, which are characterized by a more or less complete continuity. The least continuity is shown in the litoral, but even this zone is in uninterupted connection along the coasts of the continents. In the abyssal and pelagial zones the continuity is complete.

We can, however, distinguish regions topographically separated in the litoral and pelagial, but this is only possible by the combination of the climatic and topographical conditions. In high northern latitudes the continents approach each other very closely; in the southern hemisphere they are removed from each other. In the northern hemisphere, where the continents are close together, the litoral is continuous; in the southern hemisphere the pelagial has its broadest connections around the southern end of the continents; in both these regions totally different conditions of temperature exist from those of the tropical regions. They form therefore two completely isolated regions, separated by the tropical portions of the litoral. These are formed by four large divisions, one on each side of the great land areas, the old and new world. The *pelagial* is only divided into two portions, the Atlantic and Indo-Pacific, separated topographically by the two large landmasses. It is a very important point that this topographical separation of the tropical parts of these two life regions is only made possible by the climatic differentiation of their circumpolar parts.

The *abyssal* is not affected by such climatic differences and cannot be separated topographically.

Effect of the biological (biocœnotic) conditions on the distribution of animals. Since migration takes place in all directions the result will be a conflict between the different immigrants. Since in the resulting competition some forms supplant others, we may use the expression that the latter are checked by biological obstacles. Especially in those cases the struggle for existence is seen in its clearest form.

The chapter concludes with some remarks on the *means of distribution of animals. Active* and *passive* means are distinguished.

The means of distribution are different in the different groups of animals; therefore, these groups must show differences in their actual distribution. Many animals have different means of distribution in different stages of their life history. Each single group must be treated by itself for the determination of its distribu-

tion. Every attempt to treat uniformly animal groups, differing in this respect, or even the attempt to compare them, is destined to be a failure.

The fourth chapter treats about *the marine zoögeographical regions*. Ortmann constructs these regions according to the most important physical conditions which are of value to the geographical distribution of animals. It is necessary to examine the relations of each group of animals and each species of the general laws of distribution, and it is, therefore, the aim of scientific zoögeography to solve the question how the single animals behave towards the general laws. From this it follows that for the determination of general regions of distribution we have to consider separately each life region, since the fundamental physical conditions are totally different in every one of them.

The physical regions of the litoral life zone. The principal characters of the litoral are: 1, presence of light; 2, presence of the bottom; and 3, the presence of the medium, *i. e.*, the seawater. The litoral follows generally the coasts of the continents, and extends only over that part of the sea which borders the coast. The distance is of course determined by the inclination of the sea bottom. The limit is the depth to which daylight is able to penetrate, that is about 400 m. Besides there are litoral regions around each island or group of islands. The close relation of the litoral to the land produces, of course, a great difference in the facies, and, therefore, we have very different conditions of existence. The most important conditions are the climatic differences. The litoral is divided by Ortmann into the following regions:

1. Arctic Region.
   a. Arctic circumpolar subregion.
   b. Atlantic boreal subregion (with two local faunas).
   c. Pacific boreal subregion (possibly also with local faunas).
2. Indo-Pacific Region (very uniform).
3. West American Region (very uniform).
4. East American Region (probably with local faunas).
5. West African Region.
   a. Mediterranean subregion.
   b. Guinea subregion.
6. Antarctic region (numerous local faunas).

The abyssal life regions.

The principal characters of the abyssal consist in the complete absence of sun light, uniform cold temperature, relative state of rest of the medium and the slightly differentiated character of the facies. In its low temperature the abyssal approaches the Arctic litoral. The extension of the abyssal is enormous; it covers the whole bottom of the oceans. Topographically the abyssal of the whole earth is continuously connected. Therefore, it is impossible, so far, to divide the abyssal into different regions.

The physical regions of the pelagic life zone.

The pelagial resembles the litoral in the presence of sun light, but differs from it in the absence of the 'bottom.' In regard to temperature it is also more like the litoral. There is more variety than in the abyssal. The horizontal extension of the pelagial agrees nearly completely with the abyssal, and is therefore topographically uninterrupted.

But here the climatic conditions act in a manner similar to those of the litoral. In the equatorial regions we find the surface of the water of equally high temperature. Towards the poles the temperature becomes lower, and the amplitude of the oscillations increases; still farther towards the poles, the temperature of the water becomes again more uniform but cold.

The Pelagial is divided by Ortmann into four regions:

1. Arctic Region.
   a. Arctic-circumpolar subregion.
   b. Atlantic-boreal subregion.
   c. Pacific-boreal subregion.
2. Indo-Pacific Region.
3. Atlantic Region.
4. Antarctic Region.
   a. Notal *-circumpolar subregion.

* Ortmann was unable to trace the name *notalian*, whose original appliance by Gill was introduced in 1884 in a very interesting paper. The Principles of Zoögeography, a presidential address delivered at the third anniversary meeting of the Biological Society of Washington, January 19, 1883. Proc. Biol. Soc. Washington, Vol. II., 1882-1884, pp. 39. Washington, 1884.

b. Antarctic-circumpolar subregion.

The Pelagial of the Indo-pacific Region is completely isolated from that of the Atlantic Region by the notal-circumpolar subregion.

The fifth chapter is a very important one; it discusses the influence of the earth's geological changes on the distribution of animals, and the geological change of the climatic, topographical and biological conditions. The present condition of the animal kingdom is the final result of a series of geological changes, and the present distribution is caused by the conditions of former times. We know through paleontology that in former periods animals existed in regions in which they are missing to-day; the geographical distribution has, therefore, changed in the course of the earth history. There is no longer any doubt that a change in the distribution of water and land, in the climate and in the biological conditions, has taken place; the question is: how extensive was this change?

Climatic changes: The view of Neumayer that even during the Jurassic period three climatic zones existed, an arctic, temperate and equatorial, Ortmann rejects with Heilprin and Pfeffer. His view is the following: As far as our present knowledge reaches, we may assume, with certainty, that only during the course of the Tertiary did climatic differences develop. The principal point of this differentiation consists in the separation of a zone around the poles, in which the seasons of the year underwent a change in the height of temperature. This change increased until there was a sharp contrast between the new and the original uniform conditions of temperature which remained towards the equator. Before this climatic separation appeared, certainly in pre-Tertiary time, a uniform tropical climate existed on the earth, and no climatic regions could be developed in relation to the distribution of animals.

Topographic changes:

Ortmann is opposed to the theory, especially advocated by Wallace, of the consistency of continents and oceans since the oldest times. It has often been attempted, he says, to reconstruct the continents existing in former geological periods. The means of doing this consist first in the tectonic method of geology, and second in the data from the distribution of animals and plants. I shall not go into detail concerning these questions, which have been discussed lately very frequently (Blanford, Yukes-Brown, Ihering, Baur). I fully agree with Ortmann that the distribution of land and water has very considerably and frequently changed during geological times, and that these changes must have had an enormous effect on the distribution and differentiation of the fauna. The same holds good of the fluvial, the life zones of the fresh water.

But it is quite different with the marine life-zones. The litoral follows essentially the lines of the continents. All changes affecting the continent affected also the litoral. We are bound to accept for the litoral a topographical continuity existing from the earliest times. Therefore it is best to assume that in Pre-Tertiary time, before climatic differences existed, the litoral was in complete climatical and topographical continuity; and that there was no possibility of separation into regions according to climatic and topographic differences. With the appearance of the climatic differentiation in the Tertiary the conditions of the litoral changed, and they gradually reached the form in which they appear to-day. At first, however, there existed a considerable difference from the present conditions, at any rate through one part of the Tertiary times, which had its cause in the nature of the circumtropical girdle. There was still a connection between the Atlantic and Pacific, South and North America being still separated. But at the poles the Atlantic and Pacific were already climatically differentiated. There existed also probably a connection between the Mediterranean and Indian Ocean. If this was really so, there were present perhaps from the beginning to the middle of the Tertiary *two* large groups of tropical litoral; an *American* and a *Mediterranean-Indo-Pacific* region. Possibly the West African region belonged to the American litoral.

From this condition the present distribution of the litoral and its regions developed. The Mediterranean was separated from the Indian Ocean and acquired connection with the Atlantic; the Isthmus of Panama separated the East American from the West American litoral.

Especially the latter process was a relatively recent one, but it existed long enough to produce differences in the two faunas. The former conditions on the other hand can be recognized very frequently in the present distribution.

Probably the *abyssal* life-zone was formerly not so extensive as to-day. It is probable also that during periods before a decrease of temperature at the poles the conditions of temperature were quite different from our present ones. The *abyssal* may therefore be of relatively recent date.

The *pelagial* must be very old, certainly as old as the litoral and continental. It was quite continuous in former times. With the climatic differentiation of the poles a corresponding differentiation of the pelagial took place; the circumtropical belt remained for some time continuous. The separation into the Atlantic and Pacific region was produced by the Isthmus of Panama. This differentiation is very recent, and the pelagial of the two new regions are exceedingly similar.

The chapter concludes with some remarks on the biological (biocœnotic) changes of the earth history.

The sixth chapter is devoted to the *Bionomy and geographical distribution of the Decapoda.* Dr. Ortmann is an authority on this group of crustaceans. An exhaustive essay on the geographical distribution, he says, is at present not possible, since some of the smaller groups have not been sufficiently studied; but he thinks it feasible to give a general view of the bearing of the *Decapoda* on the points discussed in the former chapters.

In many ways, he says, the *Decapoda* are a typical group for zoögeographical studies. Here all the possibilities of bionomic conditions are found, and they therefore constitute an especially good example of distribution. The ancestors of the Decapoda were nectonic animals, which were dependent on the bottom, could therefore only cross in the litoral or abyssal; we may exclude the abyssal, and have to consider the first Decapoda as nectonic litoral forms.

By far the greatest number of the Decapoda *is litoral;* a great number, however, lives also in the *abyssal,* and partially quite distinct systematic groups have their main distribution in this region. The most important families which are exclusively abyssal are: the Acanthephyridæ and Nematocarcinidæ, the Glyphocrangonidæ, Ergonidæ and Thaumastochelidæ. All these as compared with their nearest relatives are more primitive groups, which must have immigrated into the abyssal, already in remote ages undergoing thereby but slight modification. On the other hand, the abyssal received more forms in later times. These are groups, the nearest relatives of which, often belonging to the same genus, are still found in the litoral. It is interesting to note that some of the latter, for instance the Crangonidæ and Lithodidæ, perhaps also the Pandalidæ, point quite definitely to the polar litoral. The opinion that the abyssal is especially characterized by primitive forms is not correct; both the litoral and fluvial possess primitive forms.

The only Decapods which have been adapted to the *Pelagial* as true planctonic Crustaceans, are the *Sergestidæ,* which represent a highly developed branch of the nectonic-litoral Penaids; they seem therefore to be of comparatively great age. The other forms of the high sea, the inhabitants of the Sargassum are quite isolated and belong to members of quite different groups. Forms like Varuna and the Plagusiinæ can hardly be considered pelagic; since they often live on the coasts, and are perhaps driven out on swimming objects more frequently to the open sea, as a result of their mode of life.

The most important *fluviatile* Decapods are the Atyidæ, the group Palæmon and Bithynis among the Palæmonidæ, the Potamobiidæ and Parastacidæ; the Aegleidæ (represented by a single form), the Thelphusidæ and Sesarminæ. The two last are partially adapted to subterranean life. These groups are of very different age, and their immigration into the fresh water has taken place at very different times; hence the geographical distribution of each of these groups must be studied separately.

True continental forms, perhaps sometimes still frequenting the sea, are the Cœnobitidæ and Gecarcinidæ; both are morphologically recent and specialized groups.

The Decapods of the litoral and abyssal inhabit all the different facies of these zones.

On the succeeding pages the characteristic

forms of the Decapods are given for the different regions.

The last chapter gives a short review of our present knowledge of the geographical distribution of the other groups of animals.

A map shows the distribution of the regions and subregions of the marine life zones, the litoral, abyssal and pelagial. G. BAUR.

Introduction to the Study of Fungi. By M. C. COOKE, LL. D., author of 'Hand-book of British Fungi,' Fungi, Their Nature, Uses, etc. 8vo., pp. 360. London, Adam and Charles Black. 1895.

This, the latest and, as stated in the preface, 'probably last contribution to British Mycology' from Dr. Cooke, is a work 'for the use of collectors.' It is divided into three parts; namely, organography, with eight chapters; classification, with fifteen chapters—by far the largest portion of the book—and two chapters upon distribution.

Under organography there is a chapter each upon: The mycelium, carpophore, receptacle, fructification, fertilization, dichocarpism saprophytes and parasites and constituents. The author, as a lifelong student of his subject, recognizes many of the difficulties that lie in the pathway of the collector and endeavors to help him to overcome them. His method is to begin with the more common and easily seen forms and pass to the less conspicuous. Thus with mycelium the start is made with the spawn, or artificial 'bricks' of the cultivated mushroom, and he afterward considers the filaments of mildews and then the more complex forms as illustrated by the ergot grains and other indurated forms. The work is fairly well illustrated, there being in the neighborhood of one hundred small wood cuts taken in large part from the author's 'Hand-book.' From one who has written so largely upon the topics considered in the book before us there is perhaps no occasion for new engravings, but there is, nevertheless, a lack of freshness that the mycologist notes upon first taking up this work.

The carpophore, defined in brief as 'the fruit-bearer,' logically and in reality follows from the mycelium, and in the chapter upon it, it is shown in various stages of complexity from the comparatively simple bearing of spores upon the free tips of threads to the globose compact structure, where the spores are produced in sacs within the closely knit tissue. The author does not hesitate to use the names of genera without stint in citing instances, and these names, being set in italics, give the pages a heavy cast of countenance that might not please the beginner upon the first acquaintance. In fact it is to be inferred that Dr. Cooke expects more of his latest work than a mere introduction. Some of his earlier books may well serve as a preparation for this. A case, and not an extreme one, is the following upon page 262: "In *Chætophoma* the penthecia resemble those of *Phoma;* but are innate in a dermatioid subiculum resembling *Fumago* or *Asterina.*" Here we have the free use of genera, but it is innate, dermatioid and subiculum that the beginner might stumble over. He will naturally turn to the glossary to find none of these words mentioned and be disappointed. Upon the other hand, he may notice in the brief glossary the following: 'Cryptogamia—applied to the lower orders of plants in which there are no conspicuous flowers as there are in Phanerogamia.' To say the least, the mind of the reviewer is left in the dark concerning inconspicuous flowers.

The chapter upon fructification precedes that on fertilization, which does not seem entirely logical; but it is to be remembered that the author holds that sexual reproduction is not well established, or, in his own words, "the instances in which sexual reproduction has been determined are exceptionally few." This subject of fertilization is treated somewhat at length with several engravings, and it is a surprise to have it finally dismissed with the remark that "experience and investigation of forty years have shown that lichens and fungi still remain practical exceptions to the rule of sexuality."

The above view naturally leads one to look at the bibliography under each subject, and it is found far from complete. For the rusts (Uredineæ) the only American authority cited is Dr. Farlow. Under the circumstances it is a pleasure to find that Ellis and Everhart receive mention under the bibliography of the Pyronomycites, Morgan under puff-ball fungi, and